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10/809,593	03/25/2004	Osamu Takaoka	S004-5249	7106

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EXAMINER	
RUGGLES, JOHN S	
ART UNIT	**PAPER NUMBER**
1756	

DATE MAILED: 09/01/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/809,593	TAKAOKA ET AL.	
	Examiner	Art Unit	
	John Ruggles	1756	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *3/6/06, 6/25/04, & 3/25/04*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-5* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-5* is/are rejected.

7)☒ Claim(s) *1 and 2* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *25 March 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☒ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Priority

Acknowledgment is made of Applicants' claim for foreign priority based on an application filed in Japan (JP) on 4/3/03. It is noted, however, that Applicants have ***not*** filed a certified copy of the JP application 2003-099925 as required by 35 U.S.C. 119(b).

Specification

The abstract of the disclosure is objected to because in lines 2-4, "using one species of gas, by changing gas pressure and probe current and scanning conditions of the ion beam 2, the diacetone acrylamide" should be changed to --using one specie[[s]] of ~~gas, by~~ gas. By changing gas pressure and probe current and scanning conditions of [[the]] an ion beam 2, [[the]] diacetone acrylamide gas **14**--. Correction is required. See MPEP § 608.01(b).

35 U.S.C. 112, first paragraph, requires the specification to be written in "full, clear, concise, and exact terms." The specification is replete with terms, which are not clear, concise and exact. The specification should be revised carefully in order to comply with 35 U.S.C. 112, first paragraph. Examples of some unclear, inexact or verbose terms used in the specification are: (1) at page 2 lines 1-3, the parenthetical expression referring to thin films "(FIB = -CVD)" is unclear, especially with regard to how this involves use of an ion beam focused to "absorb source material gas" for correcting opaque defects (e.g., by selective etching rather than coating, etc.); (2) at page 2 lines 9-10, a "carbon-containing **alloy**" (emphasis added, which suggests an **inorganic** metal carbide) is inconsistent with the following exemplary ***organic compounds*** "such as styrene, pyrene, phenanthrene, or naphthalene"; and (3) at page 3 line 17, "currently implemented in the main" should be changed (to e.g., --currently mainly implemented ~~in the~~

~~main~~--, etc.). Note that due to the number of errors, those listed here are merely *examples* of the corrections needed and do *not* represent an exhaustive list thereof.

Appropriate correction is required. An amendment filed making all appropriate corrections must be accompanied by a statement that the amendment contains no new matter and also by a brief description specifically pointing out which portion of the original specification provides support for each of these corrections.

Claim Objections

Claims 1-2 are objected to because of the following informalities: in claim 1 lines 6-7, "single gas species" should be corrected to --single gas specie[[s]]--. Claim 2 depends on claim 1. Appropriate correction is required.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 1-5 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contain subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

In claim 1 lines 5-9, the effect and degree to which each of the "irradiation quantity", "irradiation density", "scanning conditions", and "gas pressure conditions" during ion beam irradiation with the addition of a single gas specie (diacetone acrylamide, which is also disclosed as being the same as N-(1,1 dimethyl-3-oxobutyl) acrylic amide) at instant page 4 in the

summary of the invention section lines 2-3) are changed for either clear defect correction (by selective coating of light blocking material) or opaque defect correction (by selective etching to remove undesirable opaque material) are not fully enabled in the specification. For instance, is each of these conditions (a) increased or (b) decreased, and (c) to what degree, in order to change from coating to etching with the ion beam using the same gas? Claim 2 depends on claim 1.

In claim 3, the particular composition and thickness of the "light-blocking film" (lines 6-7) are not disclosed, nor is the target exposure light wavelength that is expected to be blocked by this film. While this claim recites the introduction of diacetone acrylamide as a source gas to an ion beam to correct "clear defects", the particular manner in which these components interact with the photomask material at the clear defects is not fully enabled by the specification. While the specification at page 7 lines 4-10 disclose the use of diacetone acrylamide at "a favorable gas pressure for light-blocking film-forming using temperature control" (lines 4-6) such that the "diacetone acrylamide is then broken down so as to form a light-blocking film" (lines 9-10), this description fails to describe any particular range of gas pressures or temperatures that were employed, what particular broken down reaction product(s) of the diacetone acrylamide source gas in the ion beam function to block light, and which specific range of light wavelengths would be blocked or absorbed by this material.

In claims 4-5, the particular chemical reaction(s) on the photomask for correcting opaque defects on the photomask using diacetone acrylamide as an etching gas in an ion beam are not disclosed. While the specification at page 7 lines 18-21 disclose the provision of diacetone acrylamide "in such a manner that a high transmission factor is maintained using temperature control and with gas pressure (a gas pressure enabling accelerated etching)", this description fails

to describe any particular range of gas pressures or temperatures that were employed, what particular "transmission factor" would be achieved, and for which specific range of light wavelengths. At page 8 lines 2-3, Applicants admit that when "diacetone acrylamide is used as an etching gas, it is not possible to obtain a selection ratio between chrome and glass".

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 2 and 5 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In claim 2 line 3 and in claim 5 line 6, the term "type" renders the claim(s) indefinite because the claim(s) include(s) elements not actually disclosed (those encompassed by "type"), thereby rendering the scope of the claim(s) unascertainable. See MPEP § 2173.05(b) Part E. "Type".

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-5 are rejected under 35 U.S.C. 103(a) as being unpatentable over either Kirch et al. (EP-483517 A2) or Kirch et al. (US 5,149,974) in view of Coleman (US 3,941,836), Miyazako et al. (US 4,172,732), and Komano et al. (US 5,591,970).

Kirch et al. (EP '517) teach processes and apparatus for ion beam deposition from a decomposed or broken down organic gas (e.g., styrene, N-phenyl maleimide, etc.) and ion beam etching (under appropriate conditions) to repair or correct a defect on a mask or photomask surface (title, abstract, c4/L8-15). The most commonly used focused ion beam specie is that of gallium (Ga) ions (c4/L20-21), which has been known to deposit carbon from the decomposed organic gas at a fairly high rate of about 2 cubic microns per second (c4/L1-4). This ion beam deposition is believed to be suitable for forming a selective light-blocking film to correct clear defects (to replace missing opaque material) and this ion beam etching is also believed to be inherently capable of correcting opaque defects (to remove excess opaque material) and/or projection defects (to remove excess projections on substrate material).

Kirch et al. (US '974) teach processes and apparatus for ion beam deposition from a decomposed or broken down organic gas (e.g., styrene, N-phenyl maleimide, etc.) and ion beam etching (under appropriate conditions) to repair or correct a defect on a mask or photomask surface (title, abstract, c3/L50-56). The most commonly used focused ion beam specie is that of gallium (Ga) ions (c3/L60-61), which has been known to deposit carbon from the decomposed organic gas at a fairly high rate of about 2 cubic microns per second (c3/L44-46). This ion beam deposition is believed to be suitable for forming a selective light-blocking film to correct clear defects (to replace missing opaque material) and this ion beam etching is also believed to be inherently capable of correcting opaque defects (to remove excess opaque material) and/or projection defects (to remove excess projections on substrate material).

While teaching other aspects of the instant claims that include processes for ion beam etching and ion beam deposition using an organic reactant to correct clear defects, opaque

defects, and/or projection defects on a photomask, neither Kirch et al. (EP '517) nor Kirch et al. (US '974) specifically teach the use of diacetone acrylamide as the organic reactant ***[1]*** for correcting defects on a Levenson (phase shift) mask (PSM) ***[2]***.

However, Coleman (c7/L1-5,L31-33) teaches that diacetone acrylamide (which is also known as N-(1,1-dimethyl-3-oxobutyl)acrylamide or N-(1,1 dimethyl-3-oxobutyl) acrylic amide) has been a preferred (organic) reactant over similar acrylamide compound reactants, known for many years. Similarly, Miyazako et al. (c2/L64-68) teach that 1,1-dimethyl-3-oxobutylacrylamide (also known as diacetone acrylamide) has been a particularly preferred acrylamide (organic) reactant for its ease of reaction and ready availability, again known for many years ***[1]***.

Komano et al. teach a charged beam (e.g., gallium (Ga) ion beam, etc.) apparatus and methods for deposition or etching by this charged beam apparatus using an assist gas injected through a supply opening moved to a set distance from a mask or photomask for stable gas pressure with high accuracy that further improves the quality of a mask (title, abstract, c4/L19-22, c9/L19-20,L35-40). In one method, if a defect exists in a Levenson mask phase shifter (PS), this defect is corrected by irradiating a focused ion beam (FIB) on the defect (c2/L45-47). Among other phase shift masks (PSMs), a Levenson PSM has a high resolution that is considered essential for making DRAMs, so it is necessary to completely correct any defects found on such a PSM (c2/L38-43). It is contemplated that a projection defect on a mask, such as a Levenson PSM, can be corrected by FIB gas assisted etching (c4/L2-3) ***[2]***. Figures 9A and 9B illustrate top and side views of a Levenson PSM that consists of a light-shielding portion 21, a PS portion 22, and a light-transmitting (substrate) portion 23. To correct a defect in the PS

portion 22, an ion beam is irradiated on the surface of the Levenson PSM (c10/L30-37). For KrF light (understood to mean a deep ultraviolet (DUV) wavelength of about 248nm), a missing PS portion defect on a Levenson PSM can be corrected by FIB deposition of SiO_2 from a mixture of source gases TMCTS (1,3,5,7-tetramethylcyclotetrasiloxane) and oxygen (O_2, c4/L58-59, c9/L41-45, c11/L21). Similarly, a mask defect of missing light blocking material can be corrected by FIB deposition of carbon (C) from an assist gas such as styrene or pyrene (c11/L55-58). A mask defect of excess material (such as an opaque defect) can be corrected by FIB etching using a suitable assist gas for etching (e.g., xenon difluoride (XeF_2), etc., c13/L50-52, c14/L24-26).

It would have been obvious to one of ordinary skill in the art at the time of the invention in the processes for ion beam etching and ion beam deposition employing an assisting organic reactant (e.g., styrene, N-phenyl maleimide, etc.) to correct clear defects, opaque defects, and/or projection defects on a photomask (taught by either Kirch et al. (EP '517) or Kirch et al. (US '974)) to extend such defect correction processes to Levenson PSMs, because Levenson PSMs are known to have a high resolution that is considered essential for making DRAMs and it is necessary to completely correct any defects found on such a high resolution Levenson PSM (as taught by Komano et al.) ***[2]***. It would also have been obvious in the ion beam etching and deposition processes employing an assisting organic reactant (e.g., styrene, N-phenyl maleimide, etc. as taught by either Kirch et al. (EP '517) or Kirch et al. (US '974) and/or Komano et al.) to alternatively use diacetone acrylamide as the assisting organic reactant, because (1) diacetone acrylamide is similar to N-phenyl maleimide and is therefore considered to be inherently capable as a suitable alternative assisting organic reactant for ion beam etching and ion beam deposition

to correct clear defects, opaque defects, and/or projection defects on a photomask (e.g., a Levenson PSM, etc.) and (2) diacetone acrylamide has been known for many years (a) as a preferred organic reactant over similar acrylamide compound reactants (taught by Coleman) and (b) as a particularly preferred acrylamide organic reactant for its ease of reaction and ready availability (taught by Miyazako et al.) *[1]*.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to John Ruggles whose telephone number is 571-272-1390. The examiner can normally be reached on Monday-Thursday and alternate Fridays.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 571-272-1385. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

S. ROSASCO
PRIMARY EXAMINER
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jsr